NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA

THESIS

AN ANALYSIS OF THE PROPOSED SURFACE WARFARE OFFICER CAREER INCENTIVE PAY (SWOCIP) PROGRAM USING AN ANNUALIZED COST OF LEAVING (ACOL) MODEL

by

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March 1997

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE March 1997	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE: **AN ANALYSIS OF THE PROPOSED SURFACE WARFARE OFFICER CAREER INCENTIVE PAY (SWOCIP) PROGRAM USING THE ANNUALIZED COST OF LEAVING (ACOL) MODEL**

5. FUNDING NUMBERS

6. AUTHOR(S) Nosal, David E.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT: Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE: A

13. ABSTRACT *(maximum 200 words)*

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14. SUBJECT TERMS Surface Warfare Officer, SWOCIP, ACOL

15. NUMBER OF PAGES **66**

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18 298-102

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 1997

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This thesis investigates the effect of the proposed Surface Warfare Officer Career Incentive Pay (SWOCIP) program on the voluntary separation behavior of Navy surface warfare officers using an Annualized Cost of Leaving (ACOL) model. Data provided by the Center for Naval Analyses and the Defense Manpower Data Center (DMDC), Monterey CA on surface warfare officers are used for this analysis. Multivariate probit models are estimated to predict the effects of the proposed SWOCIP program on the voluntary retention rate of surface warfare officers between six and ten years of service. These estimates are used to calculate the costs and benefits of the SWOCIP program. This thesis finds that the SWOCIP program would increase the voluntary retention rate by 2.62 percent in the sixth year of service and 1.16 percent in the seventh year of service. The effect would decrease between eight and ten years of service. The calculated savings in accessions are greater then the estimated bonus cost. These calculations indicate, therefore, that the program is cost-effective.

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I. INTRODUCTION

A. BACKGROUND

The training of Surface Warfare Officers (SWOs) by the United States Navy is a significant investment in human capital. According to the Bureau of Naval Personnel (BuPers), the average accession and training costs for SWOs in 1996 were approximately $99,903 for an officer before he or she reaches the fleet. The unique and challenging shipboard environment requires at least two additional years of "on-the-job" training before an officer attains the necessary skills to qualify for an 1110 warfare specialty designation as a fully qualified SWO. Despite the size of this investment, only about two-thirds of all SWOs extend their careers beyond their initial minimum service requirement (MSR) of four to five years. Additionally, only between 35 and 40 percent of all SWOs continue their service to 10 years of service (YOS).

BuPers (Loeffler, 1996) estimates that the retention rate to 10 YOS for SWOs averaged 37.5 percent for officers entering the fleet during the period encompassed by fiscal years 1975 to 1984. Accession shortfalls during the late 1980s and underestimated participation in various manpower reduction programs during the downsizing, such as the Variable Separation Incentive (VSI) and Special Separation Bonus (SSB) programs, may have inadvertently resulted in even lower retention rates of officers with between five and ten years of commissioned service (YCS) in the Surface Warfare community. Bupers also reported a 34 percent retention rate to 10 YOS for year groups 1982 to 1988, attributed to higher numbers of personnel accepting voluntary separation incentives during the downsizing between fiscal years 1991 and 1994. Although this rate was adequate to meet department head requirements in the late 1990s, a continuing downward trend could lead to manning shortfalls in the future.

Furthermore, BuPers also reported that underestimated accession shortfalls for year groups 1992 to 1994 would require above-average retention for those year groups to meet department head billet requirements for fiscal years 2000 to 2002. Department head requirements for FY2004 are expected to be 275 billets, and division officer billets are expected to be approximately 600.

Officers between five and ten YCS are typically lieutenants or lieutenant commanders who are serving or will soon serve as department heads onboard surface navy vessels. With the supply of these officers originating in the Navy's internal labor market, future manpower shortages could occur at the department head level without the proper balance between accession and retention in the Surface Warfare officer community. Currently, the surface warfare community is the only major unrestricted line community that does not have a retention incentive program. To reduce the likelihood of similar shortfalls while simultaneously decreasing the number of accessions, the Navy Personnel Research and Development Center (NPRDC) and Strategic Analysis Group (SAG) Corporation have recommended implementation of a Surface Warfare Officer Career Incentive Pay (SWOCIP) program to entice highly motivated and qualified division officers to stay beyond their MSR and up to ten years of commissioned service (YCS), that is between five and ten YCS (Mackin and Darling, 1996).

B. SURFACE WARFARE OFFICER CAREER INCENTIVE PAY (SWOCIP) PROGRAM

NPRDC has recommended the following eligibility requirements for a SWOCIP program:

1. The officer must have completed his or her MSR;
2. The officer must have completed no less than five years of commissioned service but no greater than eleven years of active military service;
3. The officer must have completed SWO qualification and hold a primary warfare designation of 1110 (surface warfare officer):

4. The officer must agree to serve to at least ten years of commissioned service;
5. The officer can only apply for the bonus program within a three year window after reaching five years of commissioned service.

Only the number of officers needed to fill department head billets would be awarded bonuses. Officers selected to receive the bonus would receive between $5,000 and $10,000 annually, with 50% of the bonus awarded as a lump sum at the beginning of the contract and the remaining sum distributed by annual payments over the course of the additional obligated service time. Thus, for a $5,000 annual bonus, the participant with the minimum five years of commissioned service would receive $12,500 as a lump sum in YOS 6, followed by annual payments of $3,125 for years of service 7 through 10; for a $10,000 annual bonus, the officer would receive $25,000 the first year and $6,250 for the four following years. As of this date (January 22, 1996) this program has been approved by the Secretary of Defense and is currently under consideration by the Chief of Naval Personnel for implementation beginning in FY98.

Although activation of the program in FY98 appears imminent, studies supporting the implementation of SWOCIP have noted that little information exists on the predicted effects of the financial incentive on retention of SWOs. Mackin and Darling (1996) used the 10.5 percent participation rate for the pay bonus for nuclear-trained officers in a simple inventory projection model to estimated the retention effects of SWOCIP, noting that no studies existed of non-nuclear SWO retention behavior. The authors note that the lack of empirical evidence on the participation rate promotes use of more conservative methods to measure the voluntary retention behavior without attaching an obligation, implying that an ACOL model might be used for this analysis.

C. PURPOSE OF THESIS

This thesis will develop a statistical model to investigate the relationship between the cost of leaving and the voluntary retention decisions of SWOs who began commissioned service in FY 76. Using the Annualized Cost of Leaving (ACOL) framework, this model will be used to evaluate the potential effectiveness of SWOCIP on SWO retention rates.

The remainder of the thesis is divided into four chapters. Chapter II presents the analytic framework of the ACOL model, reviews applicable literature, and discusses whether or not the ACOL model is appropriate for analyzing voluntary separation behavior. Chapter III describes the methodology and describes the data used for this analysis. Chapter IV details the results of the model and estimates the effect of the SWOCIP program on the retention decision. The results of this research are summarized in Chapter V.

D. RESEARCH QUESTIONS

The primary concern of this thesis is to statistically estimate the effect of the proposed SWOCIP program upon the surface warfare officer retention rate. Specific issues include:

1. Will the proposed SWOCIP program increase the retention of surface warfare division officers?
2. What will be the magnitude of the retention effect?
3. Will the improvement in retention warrant the cost of the program?

II. LITERATURE REVIEW

A. ANNUALIZED COST OF LEAVING FRAMEWORK

Warner and Goldberg (1984) developed the Annualized Cost of Leaving (ACOL) econometric model to predict whether or not an individual will stay or leave after he has completed his obligated service. This framework assumes that individuals seek to maximize their utility by comparing the cost and benefits to them of each career decision they make, considering both monetary and non-pecuniary returns. When an individual is deciding upon whether to remain in the military or join the civilian work force, the model assumes he balances the anticipated cost and benefits of the alternatives (staying in the military versus leaving immediately) over each possible future period n of military service, where n = 1,2,...,s where s represents the maximum allowable future periods of service. Warner and Goldberg assumed that all personnel are mandatorily retired at various points between 20 and 30 years of service, depending upon the rank of the individual.

Warner and Goldberg's model utilized the following definitions:

M_j	=	expected military pay in each future year of service, j=1,...,s
R_{jn}	=	yearly retired pay to be received after n more years of service, $j=n+1,...,T$ where T equals additional life expectancy
W_{jo}	=	future civilian earnings stream the individual expects to receive if he leaves the military immediately, j=1,...,T
W_{jn}	=	future civilian earnings stream the individual expects to receive if he leaves the military after n more years of service, $j=n+1,...,T$
ρ	=	individual's yearly discount rate
$(1/1+\rho)^j$	=	the present value of a dollar received j years in the future, at the time of the retention decision, where j=1,...,T
γ_m	=	annual monetary equivalent of non-pecuniary aspects of military life

γ_c = annual monetary equivalent of non-pecuniary aspects of civilian life

The model assumed the values of γ_m and γ_c to be fixed over time for individuals but normally distributed across individuals.

Drawing on the derivation of the empirical model contained in Rogge (1996), we first not that the utility of staying in the military through year n is greater than the utility of leaving immediately only if:

$$\sum_{j=1}^{n} \frac{M_j + \gamma_m}{(1+\rho)^j} + \sum_{j=n+1}^{T} \frac{R_{jn} + W_{jn} + \gamma_c}{(1+\rho)^j} > \sum_{j=1}^{T} \frac{W_{j0} + \gamma_c}{(1+\rho)^j} \quad (1)$$

where the first summation on the left-hand side is the present value of military pay plus the "taste" for military life over n more years of military service. The second summation represents the present value of retirement pay after military service plus civilian pay after military service until the individual dies. The right-hand side summation is the present value of civilian pay plus the "taste" for the civilian work force if the individual immediately leaves the service.

This condition for staying in the military can also be represented as:

$$C_n = \sum_{j=1}^{n} \frac{M_j}{(1+\rho)^j} + \sum_{j+n+1}^{T} \frac{R_{jn} + W_{jn}}{(1+\rho)^j} - \sum_{j=1}^{T} \frac{W_{jo}}{(1+\rho)^j} > (\gamma_c - \gamma_m) \sum_{j=1}^{n} \frac{1}{(1+\rho)^j} \quad (2)$$

or in shorter form as:

$$C_n > \delta \sum_{j=1}^{n} \frac{1}{(1+\rho)^j} \quad (3)$$

where C_n is the cost of leaving and δ is the net preference (γ_c-γ_m) for civilian over military employment. δ can be thought of as the amount the individual would be willing to pay each year to be employed in the civilian work force and not be employed by the military, assuming the annual civilian and military compensation were the same (Hogan and Black, 1991).

Dividing both sides of the equation by

$$\sum_{j=1}^{n} \frac{1}{(1+\rho)^j}$$

the condition for staying in the military becomes:

$$A_n = \frac{C_n}{\sum_{j=1}^{n} \frac{1}{(1+\rho)^j}} > \delta \tag{4}$$

for some n, where A_n is the Annualized Cost of Leaving (ACOL) after n more years of service.

This analytic framework assumes that an individual prefers a strategy of staying in the military for n more years to one of leaving immediately only if the ACOL exceeds the net preference for civilian life ($A_n > \delta$). Or, an individual will choose a strategy of leaving immediately to any strategy that involves staying in the military only if $A_n < \delta$ for all n = 1,...s. This is equivalent to finding the maximum difference between military pay and the best alternative for horizon s, or condition max. $A_n < \delta$ (Hogan, 1995). If this maximum difference would not be adequate to keep an individual in the military, neither would lesser values. Thus, the relevant ACOL value for the retention decision is the maximum over the set ($A_1 \ldots A_s$) and the relevant time period for the decision is the one over which the ACOL value is maximized.

The retention decision can be modeled using binomial probit analysis:

$$Z_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} \tag{5}$$

where Z_i is a standardized indicator variable reflecting the retention, the Xs are typical independent variables, the βs are regression coefficients. Assuming that the net tastes for civilian employment are normally distributed $N(\mu,\sigma^2)$ where μ is the mean and σ^2 is the variance, the retention decision can be written as:

$$r_i = P(ACOL_i > \delta_i) = \int_{-\infty}^{\frac{ACOL^*_i - \mu}{\sigma}} N(0,1)dZ \qquad (6)$$

where r_i is the probability of staying and $ACOL^*_i$ is max. mean ACOL value for individual i. If we let $\beta_0 = -\mu/\sigma$ and $\beta_1 = 1/\sigma$, and account for a vector of individual characteristics, $\underline{X_i}$, with coefficients, $\underline{\lambda_i}$, then we obtain:

$$r_i = P(ACOL_i > \delta_i) = \int_{-\infty}^{\beta_0+\beta_1{}^*ACOL_i + \underline{\lambda_i X_i}} N(0,1)dz \qquad (7)$$

Warner and Goldberg computed the expected military pay stream using promotion probabilities by years of service (YOS) and pay grade for enlisted personnel who left the Navy after completion of one term of service. Earnings after completion of military service were estimated utilizing an earnings function with linear and quadratic terms for years of post-military experience, branch of service, race, education and other demographic variables. In their retention models for 16 Navy enlisted occupation codes, Warner and Goldberg discovered "that variation in ACOL explains much of the variation in the probability of reenlisting." They found that for most service members at their first term reenlistment point the maximum A_n is found over the horizon of a four-year reenlistment. The only conditions where the optimal horizon was as long as 20 years was when the personal discount rate was 10 percent or lower without a reenlistment bonus program. Furthermore, married personnel reenlisted at a higher rate than single personnel. This was attributed to the greater value of non-monetary benefits available to married personnel, especially health care benefits for family members.

Additional research on the retention decision supported the importance of the economic factors modeled in ACOL. Smith et al (1991) created econometric models of first- and second-term reenlistment decisions by Army enlisted

personnel. The authors used age-earnings profiles to estimate the civilian pay stream to age 65 and promotion time models calculate the future military pay stream utilizing the ACOL-2 model, which separates unobserved factors into fixed taste (δ_i)and random term or one-factor variance (ε_{it}) components (Hogan and Black, 1991). The reenlistment decision rule can be written as:

$$\mathrm{ACOL}_{\mathrm{it}} + \delta_i + \varepsilon_{it} > 0 \tag{8}$$

ACOL-2 accounts for heterogeneity in the taste terms whereas the ACOL empirical specification only includes the fixed taste term and does not control as well for self-selection.

Smith et al (1991) found that the maximum value of ACOL occurs at both the first- and second-term decision points when the values were calculated for a 20 year horizon. Smith et al also found that being a minority, being female, in addition to the ACOL variable increased the reenlistment probability. The number of dependents positively affected retention behavior, consistent with Warner and Goldberg's study. AFQT scores had mixed results on the retention decision: scores increased the retention rate in four out of the six regressions, but decreased it significantly in the remaining two. This is not surprising, as some other studies have found that higher quality personnel positively influence the reenlistment probabilities (Daula and Baldwin, 1986) while others have found a negative relationship between AFQT scores and the reenlistment rate (Black et al, 1987).

Daula and Moffitt (1995) developed a comparison of the ACOL to dynamic programming models of first- and second-term reenlistment decisions, finding that the two types give approximately the same fit. These findings duplicate Smith et al (1991) in their effects of race, AFQT score and the number of dependents upon the retention decision.

Whereas most of the aforementioned studies focused on the retention decision of more junior enlisted personnel, Goldberg (1982) analyzed effect of

military pay on retention rates of third-term Navy enlisted personnel. This typically involved service members with lengths of service between 11 and 14 years of service who were eligible to make voluntary reenlistment decisions. He used a 20-year decision horizon, assuming third-termers either left the Navy immediately or reenlisted and stayed until 20 YOS; historically, reenlistment rates climb extremely high with increasing lengths of service because of the increasing attractiveness of the military retirement system with more YOS. Goldberg specified logit regression models for nine different occupational groups with ACOL as the only explanatory variable. Coefficients for all models were significant.

Black et al (1990) studied the separation behavior of federal civilian employees not bound by contracts by using an "Annualized Cost of Staying" approach instead of the Annualized Cost of Leaving. The authors concluded that increases in compensation significantly improve retention of federal civilian DoD employees, that females are more likely to leave their jobs than males, and that blacks are less likely to quit than whites.

The ACOL model can also be applied to officer retention models if it is modified to reflect the differences in the decision horizon applicable to between officer and enlisted communities. Whereas enlisted personnel reenlist for a fixed number of years specified in their contract (normally two to four years), officers are required to complete a minimum service requirement based upon their commissioning source and then serve from year to year. For example, Naval Academy graduates are required to serve five years after receiving their commission, and graduates from other commissioning sources are required to serve four years.

Mairs et al (1992) conducted one of the few analyses on military officer retention behavior, in which the authors developed a two-decision ACOL-2

retention model of Air Defense Artillery (ADA) officer personnel. They specified two 3-year decision windows and utilized a probit regression model including dummy variables for marital status, gender and race. They found that ACOL had a significant, positive effect upon the voluntary retention decision. Married and female personnel tended to stay in the military (duplicating Smith et al's (1991) results) while ethnic minorities were less likely to continue service.

Additional ACOL retention models support the significance of ACOL on the officer retention decision. Reibel (1996) found ACOL to significantly and positively affect the retention decision of naval aviators, as did marital status and the number of dependents; being an ethnic minority did not significantly affect this decision. Rogge (1996) also found ACOL to be significant and positive in the retention decisions of Naval officers eligible to receive the Voluntary Separation Incentive (VSI) and Special Separation Bonus (SSB) in the early 1990s. His study paralleled the previously mentioned studies in the effect of marital, dependent, and minority statuses upon the voluntary retention decision.

Not all studies utilizing the ACOL method have found the ACOL variable to be significant. A Congressional Budget Office study of the bonus program for nuclear-trained Navy officers found no significance between the annualized value of income and the voluntary retention decision. The analysis contradicted the aforementioned officer studies as it found ethnic minorities less likely to stay than their white counterparts, but it supported the notion that the number of dependents at the end of the MSR had a significant and positive effect upon the decision to stay.

The great variety of questions analyzed using ACOL illustrates the broad range of applications for this framework. ACOL, marital status, the number of dependents and ethnic minority status appear to have a significant influence upon reenlistment, retention and voluntary separation behavior.

B. THE PERSONAL DISCOUNT RATE

Warner and Pleeter (1995) define the personal discount rate (PDR) as "the rate at which individual's trade current dollars for future dollars" and "the rate at which an individual discounts money streams in decisions involving choices over time." It is a critical factor in the calculation of the future earnings streams and in the annualization of the difference of the two pay streams within the ACOL framework. A higher individual PDR means a greater discount rate on future earnings, such as retirement benefits. Numerous studies have focused on the question of the officer PDR to estimate the effects of changes in the military retirement system, since these benefits are considered a key factor in compensating for the demands of military service and changes could affect the desirability of the military as a career choice. However, this past research has been far from conclusive.

Nord and Schmitz (1985) examined a wide variety of past research in their study to assess the PDR. Table 2.1 summarizes their results. Estimates of the PDR vary from 1.2 to 39 percent, usually declining with age.

Table 2.1. Results of Selected Studies on the Personal Discount Rate (PDR)

Study	Sample Group	PDR (%)
Friedman (1957)	U.S. farm families	30
Landsberger (1971)	Israeli consumers	9-27
Heckman (1976)	U.S. consumers	18-20
Rosen (1976)	U.S. male high school and college graduates	7.2-8.7
Hausman (1979)	46 U.S. households	10-39
Leffler and Lindsay (1981)	Medical School Applicants	10
Gilman (1976)	Civilian Employees	1.2-24
Cylke et al (1982)	Navy enlisted personnel	16-20
Black (1983)	Enlisted personnel, all services	12.5

Source: Nord and Schmitz (1985).

Using the 1983 Army Research Institute (ARI) Exit Survey with an attached group of questions, Nord and Schmitz conducted a direct assessment study to derive their own PDR estimates. They administered the survey to soldiers in paygrades E-3 to E-9 undergoing processing for a permanent change in station or release from the Army. Their results infer that the PDR for the average soldier in their sample to be approximately 14.2 percent.

Warner and Pleeter found that individuals do not discount all future values at the same rate and that the PDR varies with personal characteristics.[1] They reference Gilman (1976) who derived discount rates ranging from 8.5 percent for older persons with high incomes to 16.2 percent for younger persons with lower incomes. Warner and Pleeter also quote Black (1984) who estimated average discount rates of officers and enlisted personnel to be 10.3 percent and 12.5 percent respectively. Additionally, Cylke et al (1982) stated that Navy enlisted personnel have a PDR of about 17 percent. Applying Warner and Pleeter's findings that officers have discount rates around 10 points lower than enlisted personnel, Cylke et al imply that officers have PDRs of seven percent.

C. STUDIES OF THE EFFECT OF THE SWOCIP PROGRAM

At least one study tried to determine the effect of the SWOCIP program on SWO retention behavior. Mackin and Darling (1996) analyzed the cost effectiveness and retention effects of the program utilizing an inventory projection model. They estimated the program "take" rates and pay elasticities using the experience of the nuclear-trained officer bonus program. Their study estimated that a $5,000 annual bonus would allow the Navy to access 67 fewer SWOs to reach the desired endstrength of 275 at the end of 10 YCS, saving $18 million in

[1] Although this study involves issues related to the federal government, the OMB A94 (1992) standard discount rate of 7 percent (or the more conservative real borrowing rate, which varies from approximately 4-5 percent.) is inappropriate for studies which focus upon decisions made by individuals.

training costs. A $10,000 bonus was estimated to decrease the required number of accessions by 160 and save $50 million in training costs.

One weakness with the Mackin-Darling study is that it assumed that the take rates for nuclear-trained officers would be the same as they would for SWOs who are offered a retention bonus. This is questionable because the technical skills and education nuclear-trained officers acquire through the training pipeline may increase their market value to the civilian work force relative to the average SWO. Hence, their cost of leaving under a similar bonus plan would be lower than the average SWO. More important, the responsiveness of nuclear officers to a given bonus program may differ from that of conventional SWOs.

III. DATA AND METHODOLOGY

A. DATA DESCRIPTION

Data on Surface Warfare Officers were obtained from the Center for Naval Analyses and the Defense Manpower Data Center (DMDC), Monterey. The data files compiled by the Center for Naval Analysis (CNA) contained information on the demographics, years of service, and separation dates for SWOs who entered naval service between FY 76 and FY 90. The initial data set consisted of 21,532 observations of SWOs and 90 variables. Observations for officers who had not completed 5 years of service were removed from the working data set, ensuring that remaining observations included only officers who had completed their MSR. SWOs were then assigned to year groups (YG), or cohorts, according to the fiscal year of their commission. Cohorts 76 through 78 were selected for analysis since their retention behavior could be followed through ten years of service, the desired end point for the prospective SWOCIP bonus. Officers who received their commission before 20 years of service were deleted from the SWO data subset, assuming that this variable was in error for these respective observations in the data set. Officers who had been discharged from active service involuntarily also were removed from the data set. Of the remaining 3,426 observations, 41 (or 1.2 percent) were female. The data subset for this analysis was restricted to male SWOs to facilitate ACOL computation, discussed later in this chapter.

Table 3.1 contains descriptive statistics for the data set of male SWOs who entered the Navy between 1976 and 1978. A t-test for differences in means for each variable is shown in column 6. As can be seen, age, marital status, whether or not an officer has children, and minority status are all statistically significant. The average age at entry and percent married officers vary slightly across year groups whereas the percent minority varies by nearly four percentage points from

year to year. The frequency of officers with children at 5 YOS drops steadily across year groups in the sample. Although the percent married officers at 5 YOS and percent with children at 5 YOS decline in the short term with the three specified year groups shown above, averages of future year groups in the CNA data set do not display a downward trend and maintain averages close to those listed in column 2 of Table 3.1.

Table 3.1. Mean Values of Selected Variables of Surface Warfare Officers by Year Group

	Total	YG76	YG77	YG78	t-test
Observations	3385	1147	1165	1073	
Age at commissioning	23.14	23.05	23.28	23.09	.0001*
Married at 5 YOS (%)	62.34	66.09	62.58	58.06	.0001*
Minority (%)	8.75	6.71	10.56	8.95	.0001*
Children at 5 YOS (%)	17.4	20.66	17.6	13.7	.0001*

* means for observations are significantly different at the .01 level of statistical significance

Source: Derived from data obtained from CNA.

Table 3.2 shows additional data regarding the retention decisions of officers. Officers who left the military tended to receive their commission at a younger age and also were less likely to be married at MSR, have children or be minorities when compared with surface warfare officers who chose to remain in the Navy.

Table 3.2. Mean Values of Selected Variables of Surface Warfare Officers for Year Groups 76-78 by Voluntary Retention Decision

	Stayers	Leavers
Age	23.33	22.21
Married (%)	64.85	49.46
Children (%)	18.93	9.57
Minority (%)	9.04	7.22

Source: derived from data obtained from CNA.

B. ESTIMATION STRATEGY

1. Model Development

The specification of the empirical model follows previous literature on the ACOL model. Utility maximizing behavior is assumed to guide officers faced with a career decision to stay in the military sector or leave to find civilian employment. The ACOL model is then used to predict an individual's response to a career incentive pay program. Most of the explanatory factors in previous studies (presented in the literature review above) are assumed to be applicable to the decision to accept career incentive pay and remain in the Navy. The surface warfare officer retention model is specified utilizing equation (6) in Chapter II with the probit indicator variable, Z_i, associated with staying in the military expressed as a function of ACOL and other explanatory variables (X),

$$Z_i = \beta_0 + \beta_1 ACOL_i + \underline{\lambda_i X_i} \qquad (9)$$

where Z_i represents the standard indicator variable of staying for individual i, $ACOL_i$ is the Annualized Cost of Leaving value for individual i, δ_i is the individual's net preference for civilian employment over military employment, $\underline{\lambda_i}$ and $\underline{X_i}$ are the respective vectors of parameters and individual characteristics. Individuals in the sample are assumed to have no obligated service commitments between 5 to 10 YOS, meaning that they are free to make a voluntary retention decision during each YOS.

Table 3.3 gives an overview of the dependent variables and the explanatory variables used in this estimating model. These variables are assumed to significantly affect the decision to stay in the military.

Table 3.3. Definitions of Variables Used in the Probit Retention Models

Variable name	Definition
STAY	= 0 if left the military between the 5 and 10 YOS = 1 otherwise
ACOL	Annualized Cost of Leaving ($)
MARRIED	= 1 if married at 5 YOS = 0 otherwise
MINORITY	= 1 if minority = 0 otherwise
CHILDREN	= 1 if has dependents other than spouse at 5 YOS = 0 if no dependents other than spouse

Source: Data from DMDC, CNA and author.

2. Variable Construction and Definitions

a. The Dependent Variable

The dependent variable STAY was constructed from the TIME_LOS variable in the original data set. STAY was coded 1 if the individual did not leave the military and coded 0 if he separated within the 5 to 10 year "window." Individual retention decisions for each YOS were accumulated for the 3385 officers in the sample, resulting in 15,281 individual decisions for the entire time period. For example, if an individual in YOS 6 decided to stay in the military, his intermediate dummy variable for staying in the military (STAY6) was coded = 1. If he decided to leave the military immediately, STAY6 was coded = 0 and the individual was deleted from the subset of "stayers" who made a decision in YOS 7. If he again decided to remain in the military, the dummy variable STAY7 was coded = 1 and the individual was included in the subset of officers who made a decision in YOS 8. Thus, officers who left the military were not included in subsequent years of service.

b. *Calculation of the ACOL Variable*

To calculate the value of the Annualized Cost of Leaving it is assumed that individuals derive their expectations of future income streams from current information about military pay and future promotion rates and civilian wage opportunities. It can be assumed that the typical officer weighing his retention decision during each of the years between 5 and 10 YOS in the absence of a SWOCIP program planned on staying in the military until he was vested for retirement benefits (i.e., until 20 YOS). The decision was, therefore, assumed to be between leaving the military immediately or staying until 20 YOS (when the individual is eligible for retirement benefits), using Goldberg's (1982) assumption in his analysis of mid-career personnel that the max. ACOL will normally occur at the 20-year service point, which is typically the earliest point the service member can retire. Therefore, the values calculated for ACOL considered a 20-year service point, the max. ACOL for the individual at the given decision point. For each year in which an individual made a decision, this max. ACOL was computed for the decision and included in the probit analysis.

To estimate the expected future military income stream, Navy Officer Master Files (OMF) between FY77 and FY90 were obtained from Defense Manpower Data Center in Monterey, CA. SWOs were sorted into year groups based upon the fiscal year of their commission, then the paygrade distribution by YOS was computed for each year group. Since the differences in this distribution were small between year groups (differing by no more than 3 percent in a given paygrade), an average of the paygrade distribution by YOS for all year groups in this range was computed. Paygrade frequencies were rounded to the nearest whole percent, and frequencies of less than 1 percent for a given YOS were assumed to be atypical and omitted. Table 3.4 summarizes the resulting probabilities.

Table 3.4. Average of Paygrade Frequencies by Years of Service, Surface Warfare Officers (FY 77 to 94)

YOS	O-3	O-4	O-5	O-6
6	1	0	0	0
7	.97	.03	0	0
8	.93	.07	0	0
9	.70	.30	0	0
10	.07	.93	0	0
11	.03	.97	0	0
12	0	1	0	0
13	0	.97	.03	0
14	0	.94	.06	0
15	0	.30	.70	0
16	0	.07	.93	0
17	0	.05	.95	0
18	0	.04	.93	.03
19	0	.03	.93	.04
20	0	.02	.92	.06

Source: Derived from data obtained from DMDC.

The paygrade probabilities were combined with FY81 to FY87 military pay tables to calculate the expected monthly basic pay, Basic Allowance for Quarters (BAQ) conditioned on dependent status, Federal Insurance Contributions Act (FICA) deductions, and expected Career Sea Pay. Probabilities for a change in marital status (i.e., becoming married) were computed for single personnel by averaging such changes from OMFs 1977 through 1990 and applied to the calculation for the expected BAQ.[2] Additionally, since Navy personnel

[2] If P(L) is the proportion of the SWO community married at YOS=L, the probability of becoming married at YOS=L+1 can be approximated as (P(L+1)-P(L))/(1-P(L)).

receive Career Sea Pay only when serving onboard afloat units, it was assumed that this payment was received during YOS 8 through 11 and YOS 14 through 17 (an estimated sea-shore rotation for year groups 76, 77 and 78). These data were combined to estimate the expected annual military income for each YOS. Nominal values were converted to real values using 1990 as the base year in order to keep the military and civilian pay streams at the same base year. Expected future annual military retirement benefits were assumed to be 50 percent of the expected annual military basic pay in YOS 20. The results of these calculations are contained in Appendix A.

In calculating the ACOL values after the implementation of the SWOCIP program, the bonus was included as part of military pay. It was assumed that the $50,000 bonus would be paid similarly to current Aviation Career Incentive Pay (ACIP) and Nuclear Officer Incentive Pay (NOIP). Under these programs, 50 percent of the bonus is paid in the first year with the remainder paid in equal installments over the obligated service period. Thus, $25,000 was added to the annual military basic pay for the first year and $6,250 was added for each of the remaining four years of the commitment. The bonus was therefore included in the military pay stream and discounted along with the annual military basic pay in computing the present value of the military option.

The present value of the total military income stream associated with staying until YOS 20 in the military can be estimated by summing the discounted values of annual military pay until YOS 20 and those of the military retirement benefits from the age of retirement until the age of life expectancy, or 73 years of age for men. Following Mairs et al (1992), Goldberg (1982), Warner and Goldberg (1984) and Rogge (1996), a ten percent discount rate was chosen throughout the analysis.

A civilian age-earnings profile was calculated using data from the 1990 Public Use Microdata Samples (PUMS) with the assumption that a military retiree will remain in the civilian labor force until 65 years of age. These data are based on the census of the United States and contain records representative of 5

percent or 1 percent samples of persons living in homes in the U.S. The PUMS yielded 51,212 observations of military veterans. Controlling for levels of education and receipt of military retirement benefits, the estimated age-earnings profile gave approximations of the future civilian income and retirement benefits stream of veterans. The total present value of the civilian income stream to be expected after military retirement was calculated as the sum of the discounted annual civilian pay from military retirement age until 65 years of age, plus the discounted annual civilian retirement benefits from age 65 until the life expectancy age. The present values of the military and civilian income streams were then summed to estimate the individual's perceived monetary value of staying in the military.

The same age-earnings profile was then used to calculate the discounted annual expected civilian wage of military veterans with less than 20 YOS. Consistent with Goldberg and Warner (1987) and Rogge (1996), veterans who leave the military before completing 20 YOS have higher discounted civilian earnings than those who stay for 20 YOS. The anticipated value of the discounted civilian income plus the discounted civilian retirement stream was determined by discounting the individual's annual civilian earnings, conditioned on age, then summing them from the current age until life expectancy to obtain the total present returns if the individual left the military.

The cost of leaving (COL) was calculated for each individual as the difference between the present value of staying until 20 YOS (or "returns to staying") and the present value of leaving immediately (or "returns to leaving"). This can be written as:

$$COL_i = RS_i - RL_i \tag{10}$$

where COL_i is the value of the cost of leaving for each individual at the time of the decision, RS_i is the value of the returns to staying in the military from the decision point until 20 YOS, and RL_i is the value of the returns to leaving the military immediately. RL_i consists of the summation of the discounted civilian

pay stream from the decision point until life expectancy. RS_i is composed of the sum of the discounted military pay stream and the discounted civilian pay stream after 20 YOS until life expectancy, or:

$$RS_i = MILPAY_i + CIVPAY_i \tag{11}$$

where $MILPAY_i$ is the discounted military pay stream and $CIVPAY_i$ is the discounted civilian pay stream for individual *i*.

The COL values were annualized using the ten percent discount rate to obtain the ACOL values. It is hypothesized that ACOL positively affects the probability of staying in the military, meaning that the higher the ACOL, the less likely the individual will leave the military. The SWOCIP program is expected to raise the value of ACOL, making staying in the military more attractive than leaving immediately to an individual pondering a retention decision.

c. *Demographic Variables*

Several demographic factors are also included in the retention model to capture differences in non-pecuniary factors affecting the separation decision. These include the following.

(1) MARRIED is a dummy variable which indicates marital status at 5 YOS. MARRIED = 1 if the individual is married and = 0 if he is single or divorced. Although the computation of the ACOL variable controls for differences in military and civilian income streams by including BAQ, other benefits such as health care for dependents may increase the probability that married personnel will stay in the military. The coefficient of MARRIED is expected to positively affect the decision to stay in the military.

(2) CHILDREN is a dummy variable constructed from the DEP3 variable in the DMDC data set to indicate the presence of dependents in a household other than a spouse at 5 YOS. CHILDREN = 1 signals the presence of non-spousal dependents in a household and = 0 means no additional dependents are present. Prior research has shown that individuals prefer the relative security of stable military pay over the more volatile civilian wage. Moreover, the military

medical plan and other benefits are also found to decrease the probability of leaving for an individual. The coefficient of CHILDREN is expected to have a positive sign, indicating that the presence of children in a military serviceman's household makes him less likely to leave the military.

(3) MINORITY is a dummy variable which controls for racial and ethnic differences in the retention decision. MINORITY = 1 if the individual has a non-Caucasian ethnic origin and = 0 otherwise. The potential civilian earnings of minorities tend to be restricted, but this is not captured by the ACOL variable. Therefore, the average ACOL values would tend to be greater than those of the Caucasian base case, resulting in a tendency to stay in the military rather than leave. Thus, the coefficient of MINORITY is expected to have a positive effect on the decision to stay in the military.

In summary, the specification of the probit model is displayed below. The expected sign of each variable indicates the expectations about its effect on the dependent variable, the probit indicator variable associated with staying in the military:

$$Z_{STAY} = f(\overset{+}{ACOL}, \overset{+}{MARRIED}, \overset{+}{CHILDREN}, \overset{+}{MINORITY}) \qquad (12)$$

The ACOL computations for one model would include the bonus in the calculation for military pay and would be used as a basis to evaluate the marginal probability that an individual will stay in the military, i.e., the effect on retention from the increased pay from the SWOCIP program.

IV. EMPIRICAL RESULTS AND ANALYSIS

A. METHODS

This chapter describes the estimation methods utilized in this thesis and also discusses the results of the empirical analysis. Section B discusses the findings on the simulated effect of the proposed SWOCIP program on the voluntary retention behavior of SWOs. A multivariate probit model (Equation 15) is estimated to determine the magnitude and the direction of the effect of the independent variables discussed in Chapter III on retention behavior. These models use data on SWOs in year groups 1976 through 1978, tracking their active duty status through YOS 11. Data for the three year groups were pooled into one data set to provide a significant number of observations for analysis as well as greater variability in the ACOL values. The effect of the program is estimated by comparing the retention probabilities predicted by the probit model after accounting for the change in the pay bonus, holding all other factors constant.

Section C provides a cost-benefit analysis of the program based on the simulated program effect in Section B. The number of officer accessions needed to meet the desired force structure is inversely related to the retention rate. An increase in retention means fewer officers accessions will be needed, whereas a drop in retention rates requires more commissions to meet required force levels within the internal labor market of the Navy. Accession cost savings can be compared to the cost of the bonus to determine the cost effectiveness of the SWOCIP program. The key to program effectiveness is its effect on officer retention.

This chapter also provides estimates of the marginal probabilities associated with the explanatory variables in the probit models. Marginal effects can be calculated by evaluating the probit models using the mean values of the

independent variables. The marginal effect is the change in the probability of staying in the military associated with a one unit change in a given explanatory variable, holding all other variables constant ($\Delta R/\Delta X$). The elasticity is the percentage change in the dependent variable for each percentage change in a certain independent variable. The probability of staying in the military for the average or "notional" person (i.e., a theoretical person whose values of the independent variables were set at the respective mean values of the entire population used for this model) are calculated to obtain the marginal probabilities. Each continuous variable is changed by one unit from its mean value while holding all other variables constant, thus obtaining a probability of staying for a "new" individual. The value is changed from 0 to 1 or from 1 to 0 for dummy variables, and the corresponding probability is calculated. The difference in the two resulting probabilities is an approximation of the change in the probability of the outcome (STAY) for a one unit change in the specific explanatory variable.

To determine whether or not the retention rates in the data file were realistic, these rates were compared to rates compiled by BuPers-23 and those predicted by the Center for Naval Analysis (CNA) for the years 1996 through 2000. Table 4.1 displays the BuPers retention rates, Table 4.2 shows the CNA projected rates, and Table 4.3 displays the rates from all three sources for comparison. The DMDC data file appears to overestimate the retention rates for year groups 1976 through 1978, as the rates typically run more than 10 points higher than BuPers or CNA estimates. The higher probabilities in our probit models might occur because the distribution of the sample is biased toward the higher YOS cells and thus a higher retention rate. This in turn could also decrease the anticipated effects of the SWOCIP program as the discounted increase in the military pay stream may have less of a marginal influence upon retention behavior at these more senior YOS points.

Table 4.1. Annual Retention Rates for SWOs, Year Groups 1978 to 1994 by YOS

YG	1	2	3	4	5	6	7	8	9	10
78	-	-	-	-	-	-	-	-	-	.921
79	-	-	-	-	-	-	-	-	.890	.898
80	-	-	-	-	-	-	-	.866	.901	.931
81	-	-	-	-	-	-	.861	.907	.890	.908
82	-	-	-	-	-	.867	.861	.891	.863	.92
83	-	-	-	-	.849	.871	.863	.840	.903	.876
84	-	-	-	.914	.853	.831	.827	.851	.876	.899
85	-	-	1	.916	.792	.796	.839	.827	.818	.865
86	-	1	.846	.909	.780	.807	.840	.832	.748	.902
87	1	1	.916	.932	.767	.780	.782	.730	.824	.923
88	1	1	.900	.933	.732	.807	.801	.704	.864	-
89	1	1	.85	.857	.746	.806	.868	.840	-	-
90	1	1	1	.921	.753	.817	.872	-	-	-
91	1	1	1	.899	.788	.869	-	-	-	-
92	1	1	.875	.931	.874	-	-	-	-	-
93	1	1	1	.942	-	-	-	-	-	-
94	1	1	.777	-	-	-	-	-	-	-
Ave.	1	1	.916	.915	.793	.825	.841	.829	.858	.904

Source: Derived by author from BuPers-23 data.

Table 4.2. Predicted Annual Retention Rates from FY96 to FY2000 by YOS

YOS	1	2	3	4	5	6	7	8	9	10
Rate	1	1	.894	.874	.777	.772	.856	.91	.93	.92

Source: Center for Naval Analyses.

Table 4.3. Comparison of Annual Retention Averages

Source	YOS 6	YOS 7	YOS 8	YOS 9	YOS 10
Thesis/CNA	.924	.956	.972	.987	.967
BuPers-23	.825	.841	.829	.858	.904
CNA	.772	.856	.910	.930	.920

Source: Derived by author; data from respective sources.

The average annual retention rate is lowest in the years immediately following completion of MSR (YOS 6 and 7) as individuals who do not have a high taste for military life elect to leave the military at the earliest opportunity in order to benefit from the higher present value of wages in the civilian labor force. The rate climbs through YOS 8 to 10 as the prospect of military retirement draws nearer and the present value of expected military retirement pay rises.

B. EFFECT OF PROPOSED SWOCIP BONUS ON SWO RETENTION BEHAVIOR

The results of the analysis of SWOs in year groups 1976 to 1978 with 6 to 10 YOS are included in this section. Before analyzing the retention behavior in a multivariate model, the average ACOL values were examined as a preliminary analysis of the relationship between ACOL and YOS. Table 4.4 shows that, for the YOS included for this analysis, the mean ACOL values increase with YOS. This can be explained by the increasing attractiveness of the military retirement program with YOS. Additionally, the average ACOL values are similar to those in prior retention studies (Rogge 1996).

Table 4.4. Average ACOL Values by YOS for Navy Officers in Year Groups 76-78, Bonus Taken at YOS 6 (to nearest whole dollar)[a]

YOS	Observations	ACOL Without Bonus	ACOL With Bonus
6	3385	$ 72,592	$ 80,041
7	3129	74,100	77,484
8	2991	75,427	78,056
9	2907	76,640	78,680
10	2869	78,183	79,056
Aggregate	15,281	$ 75,276	$ 78,684

[a] Real dollars (base year: 1990)

Source: Calculations by author, derived from DMDC, CNA, and PUMS data.

A multivariate probit model is used to determine the factors influencing the retention behavior of Navy SWOs in year groups 1976 through 1978. The variable (STAY) represents a binary decision, to stay in the military or leave immediately. This decision was modeled as a function of ACOL and the demographic variables listed in equation (15) in Chapter III.

Table 4.5 displays the estimated probit coefficients of the independent variables, the significance level of each coefficient, and the calculated marginal effects of each variable. The marginal effect represents the change in the probability of staying for a one unit change in the respective explanatory variable except for the ACOL variable. Since a major research question of this thesis is to determine the effect of the SWOCIP program upon the voluntary retention rate, the marginal effect of the ACOL variable was computed by calculating the difference in the simulated probabilities of a "notional individual" with and without the inclusion of the pay bonus in the ACOL calculation. This marginal effect is an estimate of the effect of the SWOCIP program on the decision behavior of eligible officers.

Table 4.5. Probit Regression Results of SWOs in Year Groups 76-78

Variable	Coefficient	Wald χ^2	Pr>χ^2	$\Delta R/\Delta X^a$ (Marginal Effect)
INTERCEPT	-0.7916	5.9185	0.0150	
ACOL	0.000026	39.8224	0.0001*	0.0108[b]
MARRIED	0.3995	99.4076	0.0001*	0.0506
CHILDREN	0.4074	58.9477	0.0001*	0.0440
MINORITY	0.0169	0.0941	0.7591	0.0022

Model chi-square = 177.033 with 4 DF (p=0.0001); n = 15281

[a]change in probability of staying for a unit change in the independent variable, calculated at the mean values.

[b]change in probability of staying in the absence of the SWOCIP bonus, calculated at the mean values.

*significant at the .01 level of statistical significance

Source: See text.

As expected, the ACOL variable was found to be statistically significant and positive in its effect on the probability of staying in the military. Although the value of the coefficient is small, it is similar to the estimated coefficients in Rogge (1996) for VSI/SSB eligible officers, Reibel (1996) for naval aviators and Mairs et al (1992) for Army officers.

The marginal effect for the ACOL variable, listed in column 5 of Table 4.5, provides an estimate of the increase in the probability of staying in the absence of a bonus. Mean values were computed for the rest of the variables and held constant. The change in ACOL was based on the change in military pay due to the SWOCIP program. The program increased the probability of staying in the military by 1.08 percentage points (1.16 percent) for the entire sample period (YOS 6 to 10 years). This is far lower than the assumption made by Mackin and Darling (1996) that SWO retention with a $10,000 annual bonus at YOS 5 would produce the same retention increase as for nuclear officers under the NOIP program (approximately 10.5 percent).

The DMDC baseline personnel data used in the ACOL analysis may also overestimate the SWO retention rates. This is indicated by the large differences between the rates calculated for the DMDC data set and both the BuPers and CNA retention rates, shown in Table 4.3 above. Therefore, there may actually be lower retention increases than the DMDC data indicate. It is unclear, however, what effect this possible bias might have on the ACOL regression coefficients or the calculated marginal probabilities. As discussed in the conclusions and recommendations for future research, further analysis of this potential measurement error is needed.

Marginal probabilities of the effects of ACOL on retention can also be calculated for each of the individual decision points (i.e., each YOS) in the model rather than for the entire 5-year period. Mean values for all variables were held

constant (except the one for which marginal effects were being calculated) while the value of the independent variable in question was changed from 0 to 1. Table 4.6 summarizes the percentage change in retention and the associated pay elasticity (%ΔR/%Δpay) for each YOS. As the ACOL rises with each YOS, the elasticity gradually decreases as the marginal effect of additional compensation upon retention drops. As individuals progress in YOS, the increasing present value of retirement benefits produces higher retention rates. The most significant retention increase occurs in YOS 6, where the SWOCIP bonus created a 2.42 percentage point (2.62 percent) increase in retention. The combined effect of a 50 percent lump sum payment, totaling $25,000 during the first year of the bonus and the low initial ACOL value combine to create a large percentage increase in ACOL (10.5 percent). This sharp increase in the cost of leaving thus creates the largest retention effect in YOS 6. The relatively low retention rates at YOS 6 contribute to a higher estimated elasticity of ACOL, meaning that individuals are more responsive to changes in compensation at this point. Consequently, the marginal effect of additional pay is greater. As YOS increases, individuals realize a higher present value in expected retirement benefits and normal retention rates climb. Thus, additional compensation from the bonus has a decreasing marginal effect upon retention.

As the bonus is assumed to be taken at YOS 6, the first year all officers can make voluntary retention decisions, the greatest increase in retention obtained by the bonus occurs at that YOS. Also, as discussed earlier, an individual receiving a $50,000 bonus at YOS 6 receives an initial payment of $25,000 and four subsequent payments of $6,250. As a result, there is the largest change in ACOL for YOS 6. Therefore, YOS 6 is employed in the cost benefit analysis to evaluate the SWOCIP program.

Table 4.6. Marginal Probabilities of Staying in the Military and Elasticities of ACOL by YOS

YOS	(1) Probability After SWOCIP	(2) Probability Before SWOCIP	(3) Marginal Probability = (1) - (2)	(4) Percent Change in Probability = (3) / (2)	(5) Pay Elasticity
6	.9475	.9233	.0242	2.62	.209
7	.9400	.9288	.0112	1.21	.200
8	.9418	.9333	.0085	0.91	.191
9	.9436	.9373	.0063	0.67	.185
10	.9447	.9421	.0026	0.28	.150
Overall	.9436	.9328	.0108	1.16	.155

Column (1) and (2) computed by taking the standard normal of the probit standard indicator. Column (3) is the difference between the probabilities computed in (1) and (2). Column (4) is the percent change in the probability, or (4) divided by (1). Column (5) is the pay elasticity, calculated by the percent change in retention by the percent change of discounted military pay from the SWOCIP program bonus.

Source: Derived by author.

The elasticities in Table 4.6 are significantly lower than what might be expected based on earlier studies of officer retention. Typically, elasticities in prior studies fell between about .4 and 1.5. Again, the extremely high initial retention rate in this data set makes changes in retention less responsive to changes in compensation.

Table 4.7 shows the marginal effects of the demographic variables on the voluntary retention rate of SWOs. The effect of minority status, MINORITY, has a slightly positive effect on retention for this sample of SWOs, but the coefficient is statistically insignificant. The percentage of minorities (8.74 percent) in this sample closely resembles the percentage in the sample of officers in Rogge's (1996) study of the VSI/SSB program (7.32 percent), and the estimated effect of minority status is the same. For these samples, whether or not an individual is a

minority had little bearing on the retention decision. Both studies contained percentages of minorities which were far below the approximate proportion of minorities in the general population (approximately 30 percent).

Table 4.7. Marginal Probabilities of Demographic Variables (X_i) with Respect to Retention

Variable	(1) $X_i = 1$	(2) $X_i = 0$	(3) Marginal Probability (1) - (2)	(4) Percent Change in Probability = (3)/(1)
MARRIED	.8391	.9497	.0506	5.67
CHILDREN	.9222	.9662	.0440	4.77
MINORITY	.9328	.9350	.0022	.0024

Source: Derived by author.

Both of the remaining independent variables MARRIED and CHILDREN are significant at the .01 level for the sample. Both coefficients are positive as well, indicating that being married and having children both increase the likelihood of remaining in the military. Since the ACOL variable incorporates differences between civilian and military earnings conditioned on marital status, the positive coefficient of MARRIED suggests that married officers have a stronger preference for military life. Additionally, fringe benefits (such as dependent health care) seem to be valued more highly by married officers or officers with children than by single officers. In fact, the medical health plan for military dependents is believed to be the major reason for the higher retention of married officers and officers with children. Holding all other things constant, being married results in an increase in the percent who remain in the Navy of 5.06 percentage points (a 5.67 percent increase), and having children results in an increase in the percent who stay of 4.4 percentage points (a 4.77 percent increase). These findings are

consistent with the results in Bautista (1996) and Rogge (1996) in their studies on officer retention rates.

C. COST-BENEFIT ANALYSIS

This section explores the expected changes in manpower costs as a result of implementation of the proposed SWOCIP program. To evaluate the economic efficiency of the program's effects, a cost-benefit analysis is conducted where the cost of initiating the SWOCIP program is compared to the benefits in the form of reduced accessions needed to meet the desired end strength goal. The cost saving from SWOs who are induced to stay in the military (and otherwise would have left) is considered the benefit of the program. If the savings from the reduced training and accession costs of SWOs who are induced to stay are greater than the cost of the implementation of the bonus program, then the SWOCIP will be cost-effective.

BuPers estimates the average cost of a SWO accession to be $48,000 per ensign commissioned. This is computed by taking a weighted average of the costs to train an officer candidate from each commissioning source: the Naval Academy, Reserve Officer Training Corps (ROTC), and Officer Candidate School (OCS). In addition to this pre-commissioning training, SWOs undergo additional post-commission training at Surface Warfare Officer School Command (SWOSCOLCOM, or commonly referred to as "SWOS") before reporting to their first duty station. This training cost includes a direct cost per trainee of $11,200 and an indirect cost of $39,893 for each newly commissioned ensign for a total average training cost of $51,093 per accession. The cost of SWOCIP program implementation is simply $10,000 per year for 5 years, or $50,000 per participant; more precisely, the cost is $25,000 for the first year and $6,250 for the next four. Discounting this bonus by an approximate average of the OMB A94 (1992)

standard (4.5 percent) for cost-effectiveness analysis results in a cost to the government of $47,422 per "taker."

The effect of the SWOCIP bonus on retention, as found in section B, can be evaluated using FY2004 department head billet fill requirement projections. As previously mentioned, BuPers predicts the officer billet fill requirement for FY2004 to be 275 department heads. Using the more conservative retention rates from CNA and BuPers, the predicted increase in the number of accessions required to reach the desired number of personnel at the department head level before implementation of the SWOCIP program can be determined. By successively multiplying the target number of department heads (275) by the inverse of each annual retention probability, the number of accessions necessary to provide the required end strength can be obtained.

The number of required accessions of SWOs after implementation of the SWOCIP program can be determined using the following procedure. One must first increase annual retention rates for the years affected by the bonus by the percent change in the probability before implementation of the program. Next, beginning with the endstrength goal 275 surface warfare officers at YOS 10, one applies the inverse of the retention rates that are applicable from YOS 6 to 10 when the SWOCIP program is in effect to determine the endstrength at YOS 6. Then, at YOS 6, one uses the estimates of the percent change in probability of accepting the bonus to determine the number who would take the bonus and the associated number of surface warfare officers who would remain in the Navy without the bonus. Finally, using the retention rates applicable to YOS 1 through YOS 6, the number of accessions needed with the bonus are calculated. Therefore, if one starts with the number of accessions and implements the bonus program, one would obtain the needed 275 surface warfare officers at YOS 10.

At the decision point, the number of personnel who accept the bonus can be determined from the marginal effects of ACOL on retention; the increase in the number of stayers can be considered the same as the number of program participants. The marginal probability, the percentage point increase in the probability of staying in the military, should not be mistakenly used for this calculation because it is not proportional to the percent of officers who will take the bonus. Once the participation is determined, the total SWOCIP program costs can be determined and compared to the cost savings from reduced accessions.

The full costs and benefits of the SWOCIP program are likely to be much more complex than the simple trade-off of reduced accessions versus the cost of the bonus payments. Furthermore, billet accession costs entail much more than evaluating the number of personnel needed at a particular point of service to meet end strength goals. Force structuring involves attention to the entire shape of the force, that is, the experience and skill structure of individuals for all years under consideration. Factors such as demographics and morale are also accounted for when making policy decisions. To evaluate the full costs and benefits of programs, all these factors must be taken into account. Accordingly, this comparison does not constitute a thorough cost-benefit analysis of the program. However, examining the net benefit between accessions and bonus participants does give a valuable partial indication of the additional accession and SWOCIP program costs.

For simplicity, this analysis assumes that participants will only be offered the bonus immediately at the end of their MSR. If officers could participate at any time during the 5-year period, the number of required accessions would be even further reduced. Although the largest increase in retention comes in YOS 6 with the $25,000 lump sum, smaller increases in the retention rate occur for each

throughout the 5 year bonus payment period. These changes result in the higher retention rates displayed in Table 4.8.

Table 4.8. SWO Retention Rates After Implementation of the SWOCIP Program, Source by YOS

Source	1	2	3	4	5	6	7	8	9	10
BuPers	1	1	.916	.915	.793	.847	.851	.837	.864	.907
CNA	1	1	.894	.874	.777	.792	.866	.918	.936	.923

Source: Calculations by author from CNA and BuPers data.

1. Cost-Benefit Analysis Using Bupers Retention Rates

Using the retention data from BuPers, the required number of SWO accessions without a SWOCIP program bonus would be 928. With the bonus, 854 officers are needed. The 74 officer decrease in accessions saves $7,33,882 (74 X $99,093). At YOS 6, the 2.62 percent increase in retention from the program means that 16 of 582 officers will take the bonus, costing $758,752 in program costs (16 X $47,422). The net benefit of the program from reduced accessions is $6,754,130, indicating the program is cost-effective. This comparison of accession savings and program costs is summarized in Table 4.9.

Table 4.9. Net Savings of SWOCIP Program for FY2004, Retention Rates Calculated by BuPers-23

(1) Participation Rate (%)	(2) # Accessions Required Without SWOCIP	(3) # Accessions Required With SWOCIP	(4) Change in Accessions Required with SWOCIP	(5) Savings of Accessions Costs	(6) # of Bonus Participants	(7) Cost of SWOCIP Bonus ($)	(8) Net Benefit = (5)-(7)
2.62	928	854	-74	$7,332,882[a]	16	$758,752[b]	$6,754,130

[a] Calculated using BuPers figures of $99,093 per accession

[b] Calculated using discounted value of bonus of $47,422 per participant

Source: Calculations by author, derived from BuPers-23 data.

2. Cost-Benefit Analysis Using CNA Projected Retention Rates

Using CNA's anticipated retention rates for FY1996 to FY2000, the baseline number of surface warfare officer accessions required to reach 275 department heads at YOS 10 is 881 before implementation of the SWOCIP bonus. If the bonus is implemented, only 812 officer accessions are required. The difference in accessions of 69 officers saves $6,837,417. Of the 506 officers eligible to take the bonus, 2.62 percent participate in the program, totaling 14 "takers." The program costs, therefore, are $663,908, resulting in a net benefit of $6,203,509. Again, the SWOCIP program appears to be cost-effective. Table 4.10 displays these results.

Table 4.10. Net Savings of SWOCIP Program for FY2004, Retention Rates Calculated by Center for Naval Analyses

(1) Participation Rate (%)	(2) # Accessions Required Without SWOCIP	(3) # Accessions Required With SWOCIP	(4) Change in Accessions Required with SWOCIP	(5) Savings of Accession Costs	(6) # of Bonus Participants	(7) Cost of SWOCIP Bonus ($)	(8) Net Benefit = (5)-(7)
2.62	881	812	-69	$6,837,417[a]	14	$633,908[b]	$6,203,509

[a] Calculated using BuPers figures of $99,093 per accession

[b] Calculated using discounted value of bonus of $47,422 per participant

Source: Calculations by author, derived from CNA data.

It is interesting that in both calculations (Tables 4.9 and 4.10) the reduction in accessions is significantly greater than the number of bonus participants. The explanation is that the SWOCIP program results in an increase in the retention rate from YOS 6 through YOS 10. In other words, SWOCIP has two effects: it increases the number of surface warfare officers at YOS 6 and also increases the retention rates from YOS 6 through YOS 10.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This thesis analyzed the effect of the monetary cost of leaving on the voluntary separation behavior of mid-grade Navy surface warfare officers. The analysis mainly focused on the changes in the number of officers who would continue serving in the military after their minimum service requirement (MSR) if a bonus were introduced. The utility maximization framework of occupational decision-making and the Annualized Cost of Leaving Model were utilized to specify retention models. Multivariate probit models were estimated to simulate the marginal effects of the proposed Surface Warfare Officer Career Incentive Pay (SWOCIP) program bonus on the retention decision via the ACOL variable. Estimating the model for Navy surface warfare officers in year groups 1976, 1977, and 1978 found that the proposed $50,000 bonus, with $25,000 paid in the first year and $6,250 annually for the next four years, would increase the retention rate in the year of service immediately following MSR by approximately 2.42 percentage points (2.62 percent). The effect would decline at a decreasing rate if offered at each of the next four YOS points (YOS 7 through 10). Using these figures with projected retention rates from BuPers, the program would cost $758,752 and reap $7,332,882 million in savings for a net benefit of $6,574,130. Using CNA retention projections, the program would save $6,837,714 in accession costs while costing $633,908. The net benefit would be $6,203,509. Under both scenarios, the program appeared to be cost-effective.

B. RECOMMENDATIONS FOR FUTURE RESEARCH

This thesis provided an analysis of the SWOCIP bonus program on the retention behavior of Navy surface warfare officers. The marginal effect of the bonus program upon SWO retention behavior was evaluated using only the

anticipated FY2004 force structure requirement for 275 department heads at the end of YOS 10. Additionally, the Navy may require a manning "floor" for surface warfare officers at YOS 5 to meet division officer billet fill requirements. Depending on the level of the floor, the acceptable minimum accessions could rise to a level where a bonus might no longer be cost effective. Within the framework of voluntary participation in the SWOCIP program, higher accessions coupled with an excessive "take rate" could drastically lower the net benefit of a SWO retention program. Future research should assess the requirement for billet floors and investigate their effect on accession and retention policy.

This study and many others (Cylke, 1982 and Black, 1983) have assumed that the personal discount rate is constant throughout one's term of military service. This may not be the case. Numerous changes occur throughout a military career, particularly for officers between YOS 5 and YOS 10. Approximately 40 percent of the officers who were single upon entry to the service will be married before the end of the tenth year of service, and more than that will have some change in their marital status (i.e., divorced, remarried, etc.). Young military couples may also start their families during this period, incurring numerous expenses ranging from health care to housing. This may tend to increase the personal discount rate at the time the individual must decide whether or not to accept the bonus, meaning that an individual would value a future dollar less than before. On the other hand, the great responsibilities of family life may cause greater fiscal responsibility over the long term as an individual plans for such events as sending a child to college or buying a house in the future, making the value of a future dollar greater than before and indicating a decrease in the personal discount rate. Future research should study the typical change in the personal discount rate over time and in relation to various demographic factors, particularly marital status and number of dependents. Any change in the discount rate will result in changes to compensation programs such as SWOCIP.

Additional study is also needed to determine the typical economic rent for the SWOCIP program. For example, the increase in retention as a result of the program can be predicted from the model in this analysis. However, when a bonus program is implemented, some who accept the bonus would typically have stayed in the military without a bonus. In other words, a voluntary program may have a higher participation rate than the empirically derived increase in retention because individuals may take the bonus even if they would have stayed in the military anyway. Better information is needed on the prospective take rate of a bonus, perhaps through a survey of junior officers.

More research should also be conducted to determine the likely participation rate of the bonus for surface warfare officers. A simple assumption that the pay elasticity will be similar between surface warfare officers with nuclear power training and convention SWOs fails to recognize that the culture of the two communities may cause differences in how they each may respond to a given compensation program. The calculated pay elasticity in this study (around .2), seemed quite low for surface warfare officers, but this might have resulted from the high baseline retention rate in the CNA longitudinal data file. This suggests that the size of the bonus may need to be higher for them than for other warfare communities to produce the same increase in retention. Further research could provide a more accurate estimate of pay the elasticity and participation rates to provide the necessary information on the effects of a continuation bonus.

A non-quantifiable factor is that the bonus will, for the first time, place conventional surface warfare officers on an equal footing with submarine, nuclear surface, and aviation officers. This recognition of the value of surface officers may contribute to a stronger community commitment. Whether this results in a higher response rate than predicted by the ACOL model, however, is difficult to predict.

Better cohort data is also needed to provide analysts with accurate information, particularly regarding retention data. The cohort data in the data file provided by CNA appeared to overstate the true retention rate in the relevant YOS cells. Many entries appeared to be missing, especially for the TIME_LOS variable which pertained to the length of service. Further, the CNA retention rates taken from the data were more than ten percentage points higher than data compiled by BuPers. Cohort files which track the marital status of SWOs throughout their career would also aid ACOL analysis. The lack of this information in the file resulted in the use of assumed probabilities of becoming married, which assist in computing the proper amount of BAQ in the discounted military pay stream but give the model less explanatory value in describing the marginal effect of marital status on the retention decision.

Other year groups or sets of year groups should also be examined for the effect of the SWOCIP program on voluntary retention. Retention behavior could differ between the sample used in this analysis (1976-78 year groups) and, for example, a year group or set of year groups from the late 1980s. The retention "climate" in the military and civilian employment opportunities might differ markedly for the more recent year group. These factors may cause the bonus to have a different effect upon the decision to stay in the military in the current climate.

Other research should examine opportunities to reduce the number of accessions. Other manpower reduction programs, such as "Smart Ship," may also help to lower the required division officer floor or the required department head fills. "Smart Ship" may enhance the performance of the SWOCIP program and yield even greater economic benefits from potential reductions in accessions and training costs.

APPENDIX: SAMPLE ACOL PROCEDURE

This Appendix describes the steps required to calculate the value of the Annualized Cost of Leaving (ACOL) variable for Navy Surface Warfare Officers. Calculations for this warfare community are unique, especially in the computation of military pay, because compensation varies according to YOS, marital status, and duty status (i.e., sea duty or shore duty). ACOL analysis relies upon the assumption that the maximum ACOL is the most critical; if this cost of leaving is not sufficient to deter an individual from leaving the military, then lesser values can not be expected to dissuade an individual either. Theoretically, to find the maximum ACOL value, one must evaluate its value at all future decision points in a prospective career, considering all possible time periods, or horizons. Warner and Goldberg (1984) point out that this rigor is frequently unnecessary for military personnel because the nature of the military retirement system causes the maximum ACOL to occur late in a career; at YOS 20, military personnel become vested in the retirement system, which consists of approximately 50% of base pay at the paygrade at the time of retirement. For this reason, a 20-year horizon is assumed for each decision point. In this analysis, each decision point (e.g., each year between 6 to 10 years of service) considered a 20-year horizon, meaning that pay streams consisted of the sum of annually discounted pay values between 6 and 20, 7 and 20, etc.

Before ACOL analysis is conducted, the proper discount rate for the sample should be chosen (see Chapter II for discussion). Based upon prior studies, the estimated rate at which typical military officers discount future earnings is approximately 10 percent. This is the rate that determines the present value of future dollars. The cost of leaving (COL_i) is based on two pay streams: the returns to staying (RS_i) and the returns to leaving (RL_i) for an individual *i*, which in turn is annualized by dividing by $(1+\rho)^j$, where ρ is the personal discount rate.

1. **Returns to Staying (RS_i).** In our example the returns to staying consist of the summation of the present value of expected future military pay, expected military

retirement pay, and discounted post-military civilian pay and discounted civilian retirement pay.

a. **Future military pay ($MILPAY_i$).** The first step in calculating future military pay is to acquire the appropriate military pay tables for monthly basic pay. These can most easily be obtained from back-issues of the *Navy Times* or from the "Manpower Costs" section of the Defense Manpower Requirements Report, published annually by the Department of Defense. The correct pay table for the corresponding decision point is the table for that year in which the decision is made. Therefore, since each of the three year groups (1976, 1977, 1978) made decisions for the same YOS in different calendar years, different pay tables must be used to compute the discounted military pay stream at the same YOS for each year group. Career Sea Pay tables were also obtained for the corresponding periods.

To determine the pay an individual can expect in future years, one must determine the probability of being in a specific paygrade at each YOS, between, say, 6 and 20 years. This was done by crosstabulating the YOS and paygrade variables in an officer master file (OMF) provided by Defense Manpower for year groups between FY77 and FY90. The average of the paygrade distributions are listed in Table 3.1 in the text. The product of the probability of being in a given paygrade and the monthly basic pay corresponding to the respective paygrade is the proportion of monthly basic pay from that paygrade which contributes to the average, or expected, value of monthly basic pay for that YOS.

Basic Allowance for Quarters (BAQ) data are also present on the military pay tables. This pay varies with marital status, which was only indicated at YOS 5 in the data set. In order to account for changes in marital status, probabilities of being married by age were obtained from *Current Population Reports* published by the U.S. Census Bureau. From these reports, the probability of marriage was calculated for each YOS based upon the average age upon commissioning. If P(L) is the proportion of the SWO community married at YOS=L, the probability of becoming married at YOS=L+1 can be approximated as (P(L+1)-P(L))/(1-P(L)). In this manner, percentages were

obtained which were applied to the married BAQ and single BAQ values to determine the expected BAQ in a given YOS.

Finally, Career Sea Pay was included in the value of MILPAY. Since surface warfare officers only receive career sea pay when serving in an afloat command, assumptions were made about a typical sea-shore duty rotation to determine which YOS include sea pay in the discounted military pay stream. It was assumed that this rotation from the years 1976 to 1978 was similar to the present officer duty rotation. Therefore, YOS 6 and 7 were considered as simulated "shore duty," where no career sea pay was added to the discounted military pay stream; YOS 8 through YOS 11 were considered sea duty (department head tour) for SWOs, where sea pay was received; YOS 12 and 13 were considered shore duty, YOS 14 through 17 were considered sea duty, and YOS 18 and 19 were considered shore duty. This special pay varies according to paygrade, so the same paygrade probabilities (Table 3.1) were used to determine the value of expected sea pay.

The three aforementioned monthly pay components were summed, then multiplied by 12 to get the expected annual pay for a given YOS. In order to keep all pay data in the same base year, nominal values for discounted military pay were converted to real dollars with base year 1990 (for reasons to be discussed below) using the Consumer Price Indices (CPI) with relation to 1990 for all pay tables.

Table A.1 contains the real expected military pay values, discounted by YOS and calculated present values for Navy officers in FY81. Column 1 indicates the YOS, and column 2 contains the conversion ratio to real dollars (base year 1990). Columns 3 and 4 show the values of expected military pay in real dollars for FY81 for each YOS by marital status (s=single; m=married). Column 5 is the stream of discount rates, which are applied in the Excel spreadsheet to the corresponding pay value for the appropriate year of service. Column 6 is the discounted pay stream for single officers from YOS 6 to YOS 20; the sum of this stream is shown at the bottom of column 6. Column 7 is the same as column five except these values are for married officers. Column 8 is for YOS 7, single officers, as the spreadsheet continues out to the right. Table A.1 contains only a small portion of the present value streams; the Excel

spreadsheet continues to the right, calculating present values of military pay for years of service 8 through 19. These present values are the value of the MILPAY variable used in ACOL computations.

Table A.1. Present Value of Real Expected Military Pay, 1991, by YOS (rounded to nearest whole dollar, base year 1990)

81 YOS	cpi	Exp. milpay, s	Exp. milpay, m	Disc-rate	s, yos 6	m, yos 6	s, yos 7
6	1.433	33862.3632	34976.664	1	33862.36	34976.66	34012.91
7	1.433	34012.91418	35011.056	1.1	30920.83	31828.23	34612.03
8	1.433	38073.2337	38950.6596	1.21	31465.48	32190.63	32250.10
9	1.433	39022.62486	39817.338	1.331	29318.28	29915.36	31967.31
10	1.433	42548.4927	43247.0802	1.4641	29061.19	29538.34	29306.49
11	1.433	42907.63116	43495.5624	1.61051	26642.26	27007.32	25593.97
12	1.433	41219.34852	41765.6448	1.771561	23267.25	23575.62	23270.44
13	1.433	41225.00256	41837.868	1.948717	21154.94	21469.44	24028.08
14	1.433	46823.93418	47285.5608	2.143589	21843.71	22059.06	22908.37
15	1.433	49106.11852	49593.264	2.357948	20825.79	21032.39	22442.39
16	1.433	52917.97303	53368.6458	2.593742	20402.17	20575.92	20478.13
17	1.433	53115.0048	53548.344	2.853117	18616.49	18768.37	17941.67
18	1.433	51189.68905	51605.196	3.138428	16310.61	16443.01	16347.09
19	1.433	51304.16282	51708.372	3.452271	14860.99	14978.07	0
					Present Value of Military Pay		
					s, yos 6	m, yos 6	s, yos 7
					338552.4	344358.4	335159

Source: Calculations by author; data from Defense Finance and Accounting Service.

Within the Excel Spreadsheet, the formulas used to sum the military pay for a given marital status and YOS can be viewed on the formula bar when the cell is highlighted. Expected cells are constructed in the following format:

$$(((a)+(b)+(c))*12)*cpi)$$

where (a) is the expected monthly basic pay value (calculated separate from the spreadsheet), (b) is the expected monthly BAQ, and (c) is the expected monthly Career

Sea Pay. These monthly values are multiplied by 12 to obtain the annual expected military pay, then multiplied by the preceding column, the CPI inflation factor (base 1990).

b. **Military Retirement Pay** was assumed to be 50 percent of the expected base pay, calculated with paygrade probabilities from Table 3.1 in Chapter III for YOS 20. This is included with the civilian earnings in columns 2 and 3 in Table A.2, which sums the expected military retirement with expected discounted civilian pay and discounted civilian retirement benefits to calculate the value of the discounted post-military civilian earnings stream.

Table A.2. Present Value of Civilian Earnings Plus Military Retirement by Age and Marital Status after Retiring from the Military, Base Year 1990

Age	tot single	tot m	year	1981		
36	52810.12	57165.12				
37	53806.12	58306.12				
38	54776.12	59418.12				
39	55717.12	60496.12	year	discount	40, s, 19	40, m, 19
40	56624.12	61534.12	1	1.1	51476.47	55940.11
41	57492.12	61529.12	2	1.21	50216.6	50850.51
42	58317.12	63474.12	3	1.331	46952.88	47689.04
43	59095.12	64366.12	4	1.4641	43278.89	43962.92
44	59823.12	65199.12	5	1.61051	39849.29	40483.52
45	60495.12	65970.12	6	1.771561	36682.12	37238.41
46	61110.12	66674.12	7	1.948717	33700.43	34214.36
47	61664.12	67309.12	8	2.143589	30926.18	31400.2
48	62153.12	67870.12	9	2.357948	28347.13	28783.55
49	62576.12	68354.12	10	2.593742	25952.49	26353.47
50	62930.12	68759.12	11	2.853117	23731.91	24099.65
51	63212.12	69083.12	12	3.138428	21675.29	22012.01
52	63423.12	69323.12	13	3.452271	19772.81	20080.44
53	63559.12	69480.12	14	3.797498	18015.63	18296.29
54	63621.12	69551.12	15	4.177248	16394.46	16649.98
55	63608.12	69536.12	16	4.594973	14890.54	15133.08
56	63520.12	69436.12	17	5.05447	13517.52	13737.57
57	63359.12	69250.12	18	5.559917	12256.05	12455.24
58	63124.12	68981.12	19	6.115909	11098.92	11278.96
59	62817.12	68629.12	20	6.7275	10038.86	10201.28
60	62259.12	68197.12	21	7.40025	9064.663	9215.515
61	61993.12	67686.12	22	8.140275	8183.487	8314.967
62	61481.12	67099.12	23	8.954302	7375.553	7493.506
63	60906.12	66441.12	24	9.849733	6639.828	6745.474
64	60271.12	65713.12	25	10.83471	5970.63	6065.058

Table A.2. Present Value of Civilian Earnings Plus Military Retirement by Age and Marital Status after Retiring from the Military, Base Year 1990 (cont.)

65	59579.12	64920.12	26	11.91818	5330.636	5447.152
66	58834.12	64066.12	27	13.10999	4783.053	4886.815
67	58039.12	63156.12	28	14.42099	4287.201	4379.457
68	57198.12	62193.12	29	15.86309	3838.748	3920.617
69	56317.12	61183.12	30	17.4494	3433.811	3506.316
70	55398.12	60131.12	31	19.19434	3068.64	3132.752
71	54447.12	59040.12	32	21.11378	2739.725	2796.284
72	53467.12	57918.12	33	23.22515	2443.939	2493.767
73	52463.12	56768.12	34	25.54767	2178.234	2222.047
					40, s, 19	40, m, 19
					618112.6	631480.3

Source: Calculations by author; data from PUMS.

c. **Discounted Civilian Pay.** The earnings stream after 20 YOS was obtained using the Public Use Microdata Samples (PUMS) from the 1990 census. After restricting the data set to veterans, 51,212 observations were used to estimate age-earnings profiles using the equation (Rogge, 1996):

$$\text{Ln (EARNS)} = 7.7 + 0.1{*}\text{AGE} - 0.0009{*}\ \text{AGE}^2 + 0.14{*}\text{MARRIED} - 0.22{*}\text{MILRET} + 0.27{*}\text{MALE} \qquad \text{(B.1)}$$

where Ln(EARNS) is the natural log of the individual's civilian income, AGE is a continuous variable, MALE and MARRIED are dummy variables, and MILRET is a dummy variable coded = 1 if the veteran had 20 or more YOS and = 0 otherwise. Since these data were values in 1990 dollars, the discounted military pay streams were inflated by their respective CPI (base 1990) to facilitate real dollar comparisons. This discounted pay stream and the expected retirement pay were summed to compute CIVPAY, the expected civilian earnings after retirement. Table A.2 displays these results for age 40. These streams are computed for each potential retirement age contained in the CNA subset.

2. **Returns to Leaving** was also derived using the PUMS, where earnings were conditioned on age and marital status to obtain the present value of the civilian

income stream if the individual left immediately to seek civilian employment. This is compiled similarly to Tables A.1 and A.2. These present values were assigned the variable RL for ACOL calculations.

3. **ACOL computation.** After the paystreams have been developed, the cost of leaving can be computed by taking the sum of MILPAY and CIVPAY and subtracting RL. The resulting COL is annualized, then is divided by the number of years remaining to the end of the horizon to obtain ACOL.

As an example, consider the value for a married officer with six years of service in FY81, who was 20 years of age when he received his commission. His present value of his expected military pay if he should stay in for until YOS 20 (MILPAY) can be found in Table A.1 at the bottom of column 7 ($334,358). The present value of his expected earnings after he completes his military service (CIVPAY) can be found in Table A.2 under the column corresponding to his retirement age (40) and marital status ($631,480). The sum of MILPAY and CIVPAY are his returns to staying (RS) if he should stay until YOS 20, retire from the military, and work in the civilian sector until he retires from his second career. In this case, RS = $334,358 + $631,480, or $965,838. Similarly, his returns to leaving the military immediately (RL) can be found in a similar Excel spreadsheet column ($393,354). Therefore, his cost of leaving (COL) in 1981 is the difference between his returns to staying and his returns to leaving (RS - RL), or $572,484. His annualized cost of leaving (ACOL) is obtained by dividing by the sum of the discount factors (as shown in equation 4, Chapter II) to YOS 6, 8.103 in this case, multiplied by the years remaining from the decision point to the horizon (13). For this case, the COL is divided by 105.339 (8.103 X 13) to obtain an ACOL value of $5,436.

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   Ft. Belvoir, VA 22060-6218

2. Dudley Knox Library 2
   Naval Postgraduate School
   411 Dyer Rd.
   Monterey, CA 93943-5101

3. Dr. Stephen L. Mehay (SM/Mp) 2
   Department of Systems Management
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4. Dr. Gregory G. Hildebrandt (SM/Hi) 2
   Department of Systems Management
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5. Navy Manpower Analysis Center 1
   Code 531
   NAS Memphis
   5820 Navy Rd.
   Millington, TN 38054-5056

6. LT David E. Nosal 2
   c/o Dan Johnson
   105 E. 6th Street
   Hickman, NE 68372